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Effect Of Application Dentin Bonding Agent On The Retention Of Cast Metal Crowns Cemented With Glass Ionomer Cement, To Reduce Post-Operative Sensitivity. An In Vitro Study.

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Abstract

Purpose- To study the effect of dentin bonding agent application on the retention of cast metal copings cemented with Glass Ionomer cement and comparing the above with copings only cemented with GIC and to know how much is the difference in retention.

Material and methods- Samples consisted of extracted teeth prepared in anatomic form having 5-6 degree of convergence, wax spacer fabricated upon it with special tray for impression making. Metal casting was fabricated consisting of coping and a ring cemented with GIC after applying denting bonding agent on 15 samples and directly without applying bonding agent on 15 samples. They were thermo cycled and pull test was performed with Universal Testing Machine.

Result –Mean and standard deviation for tensile bond strength of group A and group B was 1.30, 1.50 and 0.16, 0.13 MPa and t test showed value about 1.37MPa implicating that there were no significant differences between the two groups.

Conclusion -Dentin Bonding Agent can be applied to vital tooth preparations to occlude the dentinal tubules and reduce the risk of post cementation sensitivity, provided the taper of the preparation ensures nearly parallel walls and optimum crown height is present to increase the bond strength of GIC in the present of DBA.

Keywords- Glutaraldehyde-based sealer, Glass Ionomer cement, tensile bond strength, Metal casting.

Introduction

When teeth are prepared for complete crowns, approximately 1.2 to 1.5 mm of tooth structure is removed to ensure appropriate crown contours and adequate occlusal clearance. Richardson et al[2] reported that approximately 1 to 2 million dentinal tubules are exposed during an average tooth preparation for a posterior crown.

Brann- Strom's hydrodynamic theory speculated that any stimulus to dentin can be transmitted back to nerve receptors. He also postulated that this occurred as a result of fluid movement in the dentinal tubules with stimulation of the odontoblasts, which elicited a response by nerve fibers and resulted in pain. Dentin hypersensitivity after cementation of interim restorations has been attributed to micro leakage and formation of bacterial by-products. However, hypersensitivity has been reported even after cementation of definitive prostheses with the most widely

used luting agents like zinc phosphate and glass ionomer cement (ZPC and GIC).

The polymerizable products like dentin bonding agents seal the orifices of the exposed tubules. However, their effect on the properties of the luting cements has not been studied extensively.

Although retention of prosthesis is mainly determined by the geometric form of prepared tooth, the interplay between mechanism of action of desensitizer and mode of attachment of the luting agent can have variable effect on the resultant forces responsible for debonding of the cemented castings.

Material and methods

30 freshly extracted molars (Fig. 1), mounted on acrylic blocks of 2.5 cmx1.5cm, were prepared to anatomic form by a single operator ensuring a standard height of 5mm and a taper of 5 to 6 degree for each sample ensuring a Schamfer finish line(Fig. 2).

Fig 1- 30 extracted molars mounted on acrylic blocks

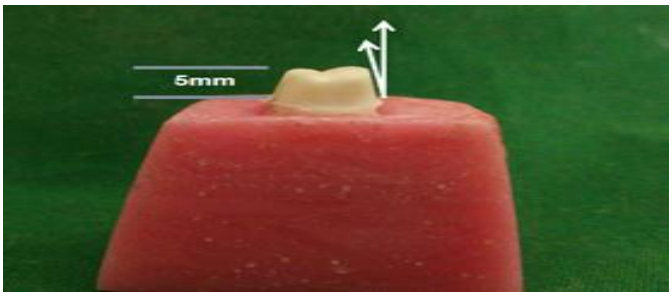

Fig. 2- Standard Height of 5mm and a Taper of 5 To 6 Degree

Wax spacer made up of modeling wax (Fig. 3) was having the dimension of 3mm was given upon the prepared tooth structure to gain the space for the impression material along with the fabrication of special tray upon it to carry the material for each sample (Fig. 4).

Fig. 3- 3mm Wax Spacer Made Up Of Modeling Wax

Fig. 4- Special Tray

After making the impression it was poured with dental stone and base were made ,upon it wax copings with rings were fabricated for casting (Fig. 5 and 6).

Fig. 5- Wax Copings

Fig. 6- Metal Copings After Casting

For Group A first dentin bonding agent (PRIME AND BOND NT, DENTSPLY) was applied first and light cured for blocking the exposed dental tubules and were then cemented with GIC cement (Fig. 7).

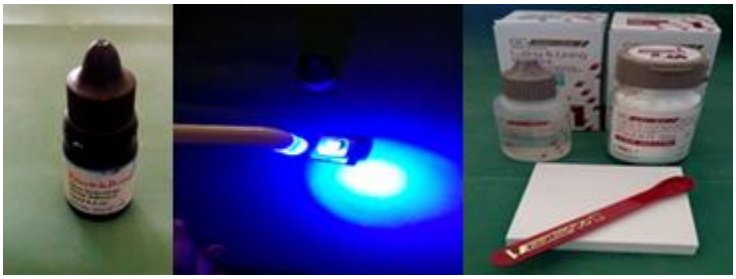

Fig. 7- Dentin Bonding Agent Light Cured Then Cemented With GIC Cement

For Group B copings were cemented without the application of the denting bonding agent.

The samples were thermocycled 500 times in a thermocycling chamber at a temperature range of 5 to 55 degree with a dwell time of 1 minute. The samples were subjected to "pull out" test i.e. tensile bond strength test on a UNIVERSAL TESTING MACHINE (UNITEST 10) and the result of peak load to dislodge the copings was noted (Fig. 8).

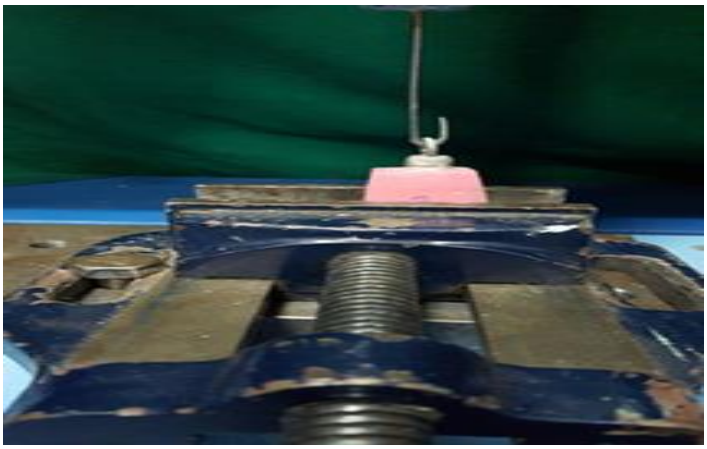

Fig. 8 - UNIVERSAL TESTING MACHINE (UNITEST 10)

After pull test were done deboned samples were obtained of Group A (Fig. 9) and Group B (Fig. 10).

Fig. 9-Group A sample with bonding agent

Fig. 10- Group B sample without bonding agent

Results

The result for each sample was divided by the surface area of each tooth to get the bond strength.

For the surface area calculation, the prepared tooth was considered to be a 5 sided cuboid and the surface of each side was calculated and added.

Selection and mounting of specimens, tooth preparation, fabrication of wax patterns and metal copings, cementation, storage conditions and the tensile testing conditions were standardized to minimize the effect of variable factors on the observations and the final result.

Since different molars vary in their anatomic form, the surface area was calculated for each sample. (table 1 and table 2).

Table 1-Group A- Bonding agent applied to prepared teeth and Copings cemented with GIC

SR NO	SAMPLE	LOAD(N)	SURFACE AREA (mm^2)	TENSILE BOND STRENGTH (Mpa)
1	No .1	190.50	172	1.12
2	No .2	200.80	182	1.10
3	No .3	210.35	202	1.04
4	No .4	180.08	168	1.07
5	No .5	173.95	160	1.08
6	No .6	165.35	155	1.06
7	No .7	220.87	150	1.47
8	No .8	230.05	162	1.42
9	No .9	185.06	155	1.19
10	No .10	257.08	175	1.46
11	No .11	212.45	165	1.29
12	No .12	190.07	172	1.11
13	No .13	168.23	170	0.98
14	No .14	177.80	162	1.09
15	No .15	190.95	178	1.07
				Mean 1.17

Table 2-Group B – Copings cemented only with GIC

SR NO	SAMPLE	LOAD(N)	SURFACE AREA($mm^{2)}$	TENSILE BOND STRENGTH (Mpa)
1	No .1	250.05	155	1.61
2	No .2	275.08	178	1.54
3	No .3	210.55	162	1.29
4	No .4	230.80	172	1.34
5	No .5	195.85	152	1.28
6	No .6	208.35	152	1.37
7	No .7	212.35	165	1.28
8	No .8	187.75	162	1.16
9	No .9	247.60	175	1.41
10	No .10	225.10	170	1.32
11	No .11	260.90	162	1.61
12	No .12	215.60	172	1.25
13	No .13	227.85	160	0.42
14	No .14	265.08	172	1.54
15	No .15	245.85	168	1.46
				Mean 1.39

The mean bond strength for group A was 1.17 Mpa and for Group B was 1.39. Unpaired t test was used to analyze the data (table 3).

Statistical Analysis

Table 3: Mean And Standard Deviation (SD) For Tensile Bond Strength

GROUPS	MEAN	SD
A	1.30	0.16
B	1.50	0.13
T TEST	1.37 (P VALUE=0.0908 < 0.05) No Significant Difference Between Two Groups	

Though the bond strength of group B samples were more than Group A, the results are however statistically insignificant.

Discussion

Musner et al, [6]reported mean force of 135N with IMPERVA bonding agent and GIC and a mean force of 211.38N with ALL BOND. The copings cemented only with GIC showed a mean force of 234.74N. Similar results were obtained in our study the mean force with PRIME AND BOND NT was 196.906N and with GC1 GIC was 230.584N.

The results were consistent with the findings of Swift et al.[7] who studied the effect of resin primers and adhesives on the retention of crowns. They concluded that the two agents used in the study, that, Gluma desensitizer or One Step had little or no effect on the retention of crowns luted with GIC.

Sharma et al. reported a decrease in retentive values when a resin‐based sealer (One Step) was used with ZPC and an increase in retention with GIC. (Sharma S, Patel JR, Sethuraman R, Singh S, Wazir ND, Singh H. A comparative evaluation of the effect of resin based sealers on retention of crown cemented with three types of cement ‐an in vitro study. [8]

Johnson et al.,[19] also concluded that resin sealer (One Step) decreased the casting retentive stress by 42% when used with zinc phosphate. However, their findings regarding 55% increase in retention when sealer was used in conjunction with GIC, was inconsistent with the results of this study. (Johnson GH, Hazelton LR, Bales DJ, Lepe X. The effect of a resin‐based sealer on crown retention for three types of cement. J Prosthet Dent 2004; 91:428‐35.)

The results were inconsistent with the findings of Manisha R et al, where a significant reduction in bond strength of GIC was found with the application of bonding agent.[1]

Post cementation hypersensitivity is a common complaint of patient receiving fixed prosthesis over vital teeth. Rosenstiel et al[13] in his study, showed that the incidence of this postoperative complication is usually underestimated by most dentists. (

Postoperative hypersensitivity was observed after cementation with the conventional glass-ionomer cement Ketac-Cem after 1 week (5.9%), 6 months (5.9%), 12 months (6.4%), and 24 months (none).[11] Application of desensitizers, lasers, varnishes have been done in the past to overcome sensitivity issues. This study used commonly available DBA which could be used prior to cementation.

In previous studies it has been shown that dentin bonding agent is a powerful desensitizer to reduce hypersensitivity as it blocks the dentinal tubules by forming resin tags. The resin layer acts as a mechanical buffer, protecting the dentine and tubule fluid from displacement on application

of tactile loads and limiting the hydrodynamic effect in the pulp.

In the presence of the DBA the chemical bond of GIC to tooth is however jeopardised but since it is commonly implicated that the geometric form of the prepared tooth with suffiicient height and nearly parallel walls, is the utmost driving factor for retention of any fixed prosthesis onto the tooth, or in other words “we do not depend on the cement for retention”, application of a desensitizing agent like DBA can be done prior to final cementation with GIC.

This method can be implicated clinically in the following conditions:

1. Tooth preparations with nearly parallel walls and optimum crown height.

2. Patients with history of dentinal hypersensitivity as it is documented that in such cases the diameter of dentinal tubules in wider than those of non-sensitive dentine where polyacrylic acid can enter into the tubules to further aggravate hypersensitivity.

Conclusion

From the results of this study, it can be concluded that Dentin Bonding Agent can be applied to vital tooth preparations to occlude the dentinal tubules and reduce the risk of post cementation sensitivity, provided the taper of the preparation ensures nearly parallel walls and optimum crown height is present to increase the bond strength of GIC in the present of DBA.

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